TREATMENT OF SLUDGE OF PURIFYING TANK

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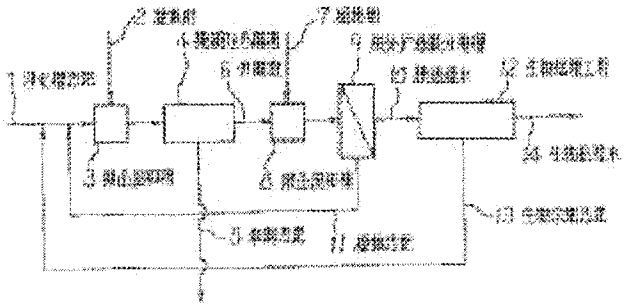
Abstract of **JP 5068993 (A)**

PURPOSE:To miniaturize an apparatus by a method wherein solid matter is separated and removed from the sludge of a purifying tank and, after a flocculant is injected in a separated liquid, this separated liquid is separated into membrane transmitted water and a membrane conc. liquid by an ultrafiltration membrane separation means and membrane separated water is treated with a biological treatment means to obtain high nitrogen removing function. CONSTITUTION:Purifying tank sludge 1 and a flocculant 2 are mixed in a chemical mixing tank 3 to flocculate and grow particles and the mixture is introduced into a mechanical separation tank 4 to be separated into excessive sludge 5 and a separated liquid 6.; Next, the separated liquid 6 and a flocculant 7 are mixed in a chemical mixing tank 8 to perform flocculation reaction and introduced into an ultrafiltration membrane separation tank 9 to block all part of SS a greater part of and soluble matter, and this blocked mixture is fixed as solid matter by a flocculant to be removed as flocculated sludge 11. Membrane transmitted water 10 is introduced into a biological treatment process 12 and nitrogen slightly remaining in the membrane transmitted water is almost perfectly removed by biological digesting and denirifying action and the biological excessive sludge 13 generated in this process 12 is circulated to the mechanical separation tank 4 along with flocculated sludge 11 to be discharged as excessive sludge 5.



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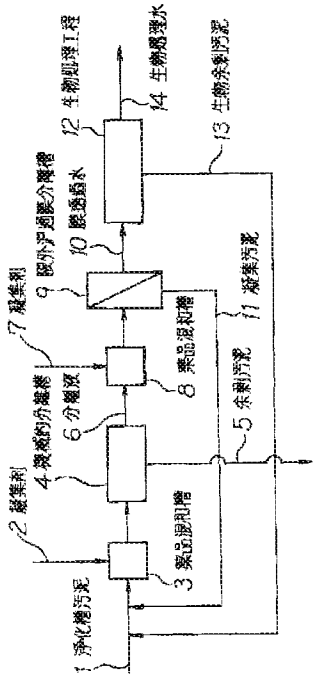
(54)【発明の名称】　浄化槽汚泥の処理方法

(57)【要約】

【目的】　浄化槽汚泥の処理方法に関する。

【構成】　浄化槽汚泥を機械的分離手段により固形物を分離除去した液に凝集剤を注入した後、限外ろ過膜分離手段にかけて膜透過水と膜濃縮液に分離し、膜分離水は生物処理手段に導いて処理し、膜濃縮液と生物処理手段で発生する生物余剰汚泥は前記機械的分離手段に循環させて、まとめて余剰汚泥として系外に排出させる浄化槽汚泥の処理方法。



1

【特許請求の範囲】

【請求項1】　浄化槽汚泥を機械的分離手段により固形物を分離除去した液に凝集剤を注入した後、限外ろ過膜分離手段にかけて膜透過水と膜濃縮液に分離し、膜分離水は生物処理手段に導いて処理し、膜濃縮液と生物処理手段で発生する生物余剰汚泥は前記機械的分離手段に循環させて、まとめて余剰汚泥として系外に排出させることを特徴とする浄化槽汚泥の処理方法。

【発明の詳細な説明】

【0001】

【産業上の利用分野】本発明は浄化槽汚泥の処理方法に関する。

【0002】

【従来の技術】従来の単独処理浄化槽（生活系雑排水の混入がない）汚泥の処理方式を図3によって説明する。

【0003】図3において、凝集剤混和槽23で浄化槽（図示省略）汚泥1に凝集剤2を注入後、固液分離槽24によって固形物（分離汚泥）及びコロイド性・溶解性物質の一部25を排除し、分離液を後流の生物処理（希釈活性汚泥法）手段にかけるという基本構成を採っている。凝集剤2としては高分子凝集剤が一般的に使用され、固液分離槽24としては重力分離槽、浮上分離槽、機械的分離槽などが使用される。固液分離槽24で排除された固形物25は汚泥処理工程（図示省略）で処理される。

【0004】なお、図3において、26は希釈水、27は希釈調整槽、28は曝気槽、29は返送汚泥、30は曝気空気、31は沈殿槽、32は余剰汚泥、33は処理水を示す。

【0005】

【発明が解決しようとする課題】図3に示した従来方式では、その中心となる生物処理施設に次のような基本的問題点がある。

【0006】（1）有機物および固形物の除去機能しかなく、窒素除去機能がほとんどない。すなわち、BOD、CODの一部、SS（浮遊物）の除去機能はあるが、有機態窒素、アンモニア態窒素は浄化微生物がその増殖の窒素源として資化する分（流入窒素の10～15%程度）程度の除去機能しかない。

【0007】（2）装置容積が過大である。すなわち、返送汚泥量を除いた原液流量基準の総平均滞留時間は3日であり、窒素除去機能を付与するには、これを2倍以上としなければならない。

【0008】本発明は、従来方式のこれら基本的問題点を克服し、高率の窒素除去機能を有し、なお装置容積の小さい生物処理法を提供することを目的として行ったものである。

【0009】

【課題を解決するための手段】本発明は浄化槽汚泥を機械的分離手段により固形物を分離除去した液に凝集剤を

2

注入した後、限外ろ過膜分離手段にかけて膜透過水と膜濃縮液に分離し、膜分離水は生物処理手段に導いて処理し、膜濃縮液と生物処理手段で発生する生物余剰汚泥は前記機械的分離手段に循環させて、まとめて余剰汚泥として系外に排出させることを特徴とする浄化槽汚泥の処理方法である。

【0010】高率窒素除去機能付与と生物反応槽容積削減を同時に達成するには、生物処理工程の工夫とともに生物処理にかかる汚濁物負荷（とくに窒素負荷）を低減することが必要であり、前処理機能の強化、固液分離工程の改善が必要である。

【0011】そこで、本発明では（1）固液分離方法として、固形物、コロイドを完全除去でき、溶解性物質の一部も除去できる限外ろ過膜を適用してBOD、COD、SSはもちろんのこと、有機態窒素も高率で阻止・濃縮すること、（2）阻止された汚濁成分は固形物として固定化しておかなければ単なる濃縮にすぎず汚泥処理工程における脱水ろ液に流出して結局生物処理の負荷となるので、膜分離の前に凝集剤を注入して固定化すること、（3）膜分離で発生した凝集汚泥および生物処理で発生した生物余剰汚泥をいずれも機械的分離工程に導入し、まとめて余剰汚泥として取り出し、余剰汚泥発生系統の一元化をはかるものである。

【0012】すなわち、本発明の特徴とする点は、①浄化槽汚泥処理における生物処理の前処理として限外ろ過膜分離を適用する点、②この限外ろ過膜分離の前に凝集剤を注入する点、③限外ろ過膜分離より発生した凝集汚泥および生物処理より発生した生物余剰汚泥を限外ろ過膜分離の前の機械的分離工程に導入する点の3点である。

【0013】

【作用】①　限外ろ過膜分離の適用により、BOD、COD、SS、有機態窒素除去が可能となり、これによって後段生物処理にかかる負荷を軽減できる。

【0014】②　凝集剤注入により、膜分離で阻止したBOD、COD、有機態窒素などの汚濁成分を固形物として固定化でき、微細粒子の凝集・粗大化によって膜透過流束が増大・安定化する。（固形物、コロイドの凝集粗大化によって膜透過抵抗が減少して透過流束が高く維持され、透過流束の安定性も増大する。

【0015】③　凝集汚泥、生物余剰汚泥の機械的分離手段への導入により、余剰汚泥発生系統が一元化され、プロセスが簡易化される。

【0016】

【実施例】以下、本発明の一実施例を図1によって説明する。浄化槽汚泥1と凝集剤2を薬品混合槽3で混合して粒子凝集・粗大化を行った後、機械的分離槽4に導入して余剰汚泥5と分離液6に分離する。機械的分離槽4では主として粗大固形物（SS）の除去を行うが、これによって若干の溶解性物質の除去も行われる。あらかじ

3

め粗大固形物を除去しておくと後段限外ろ過膜の透過流束を大きく、しかも安定化することができる。この分離液6と凝集剤7を薬品混和槽8で混合して凝集反応を行った後、限外ろ過膜分離槽9に導入して、SS100%と溶解性物質の大半を阻止し、凝集剤で固形物として固定化し凝集汚泥11として除去する。この凝集汚泥11は機械的分離槽4の前に循環する。

【0017】膜透過水10は生物処理工程12に導入し、膜透過水中に若干残留する窒素（アンモニア態窒素が大半）を生物学的消化脱窒素作用で、これをほぼ100%除去する。生物処理工程12から発生する生物余剰汚泥13は凝集汚泥11と同様に機械的分離槽4に循環する。凝集汚泥11と生物余剰汚泥13は機械的分離槽4よりまとめて余剰汚泥5として排出される。

【0018】こゝにおいて、限外ろ過膜の分画分子量、モジュール型式、膜材質は問わない。膜材質としてはポリアクリルニトリル、ポリオレフィンなど市販の限外ろ過膜であればよく、モジュールはチューブラ型、ホロファイバー型、平膜型、スパイラル型などいずれでもよい。余剰汚泥5は汚泥処理工程（脱水、乾燥、焼却など）で処理される。凝集剤としては硫酸バンド、塩化第二鉄、高分子凝集剤などがあげられる。

【0019】本発明の効果を確認するために、図1と同じフローの実験装置を用いて実験を行った。あるし尿処理場より採取した浄化汚泥1を薬品混和槽3に導き、凝集剤2を所定量添加し機械的分離槽（こゝでは遠心分離）4で余剰汚泥5と分離液6とに分離し、この分離液6を薬品混和槽8に導き、凝集剤7を所定量添加し、急速撹拌（撹拌翼回転数：120～150r．p．m）120分、緩速撹拌（撹拌翼回転数：50r．p．m）3＊0分実施し、凝集反応を行った後、限外ろ過膜分離槽9に導入して回分式で膜分離を行った。

4

【0020】こゝにおいて、限外ろ過膜分離槽9の膜分離モジュールの基本諸元は下記の通りである。

① 膜種類：膜材質ポリアクリルニトリル（有効面積0．42m²）、分画分子量100000。

② 膜モジュール：チューブ型

③ 膜分離条件：平均透過圧力1．5kg／cm² G、温度22～23℃

④ 凝集剤：硫酸バンド、塩化第二鉄、注入率：いずれも300，500ppm

【0021】図2は図1の膜ろ過水10を生物処理工程の試験装置の概略図であり、前処理（限外ろ過膜分離槽9以前の工程）とは切り離して行った。図2の生物処理工程の試験装置は原液（膜透過水10）貯槽15、原液ポンプ16、硝化槽17、脱窒槽18、再曝気槽19、沈殿槽20、処理水21排出ライン、返送汚泥22返送ライン及び余剰汚泥13返送ライン（この余剰汚泥13は図1の機械的分離槽の前に返送される）よりなるものである。

【0022】原液（膜分離水10）流量基準の総平均滞留時間は3日間である。硝化槽17ではBOD除去を硝化（NH_4－N酸化）を行い、脱窒槽18では硝化槽17で生成した酸化態窒素の還元を行うが、必要に応じて炭素源としてアルコールを注入する。再曝気槽19はこの残留アルコールを除去するためのものである。

【0023】図1、図2の実験装置により得られた結果を表1に示す。

【表1】

単位ppm（平均値）

	浄化槽汚泥機械的分離液	機械的分離液の膜処理液	生物処理水
BOD	360	65	9
T－N	150	85	18
SS	1200	0	5

（注）T－N・・・全窒素

【0024】生物処理の総平均滞留時間3日で処理水のT－Nは20ppm以下を維持しており、（従来法では生物処理工程出口で150～200ppm）本発明方法は従来方法と比較して生物処理容積を増加させることなく、高い窒素除去機能が付与されていることが判る。この要因は膜処理の追加による前処理機能の向上にある。

【0025】

【発明の効果】本発明により、高率の窒素除去を生物処理装置の容積増大を行うことなく可能にすることができる。

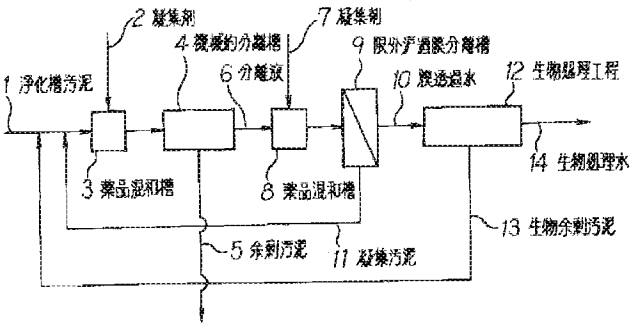
【図面の簡単な説明】

【図1】本発明の一実施例の説明図。

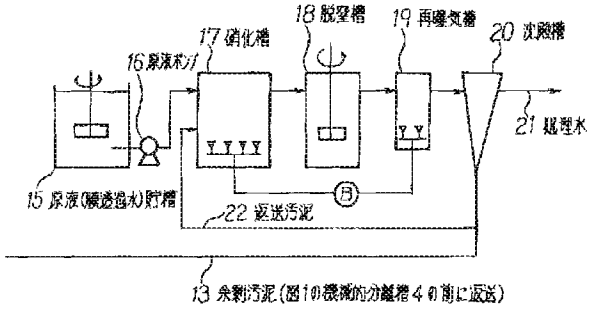
【図2】本発明の一実施例の生物処理工程の説明図。

【図3】従来の浄化槽汚泥の処理方法の一態様の説明図。

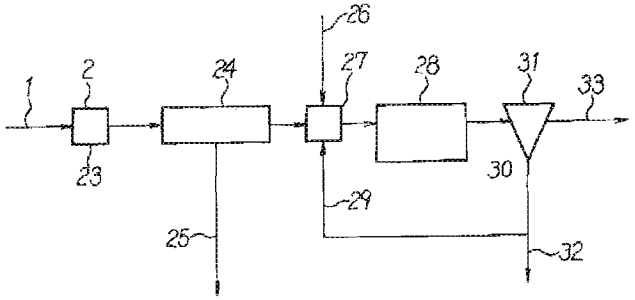
【図1】



【図2】



【図3】



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A METHOD TO TREAT SEPTIC TANK SLUDGE

[浄化槽汚泥の処理方法]

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UNITED STATES PATENT AND TRADEMARK OFFICE
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FOREIGN TITLE	[54A]:	浄化槽汚泥の処理方法

[Claims for the Patent]

[Claim 1] A method to treat septic tank sludge, comprising: after a coagulant is poured into a liquid in which solid substances of septic tank sludge are separated and removed by a mechanical separation means, the liquid is separated to membrane-permeated water and membrane-thickened fluid by an ultrafiltration membrane separation means; the membrane-thickened water is led to a biological treatment means and is treated; the membrane-thickened fluid and excess biological sludge caused by the biological treatment means, are circulated by said mechanical separation means and are discharged together as excess sludge to the outside of the system.

[Detailed Description of the Invention]

[0001]

[Industrial Application Field] The present invention relates to a method to treat septic tank sludge.

[0002]

[Prior Art] A treatment system in conventional single treatment septic tank (without any mixing of domestic wastewater) sludge is described referring to Fig. 3.

[0003] In Fig. 3, a basic structure adopted is that a coagulant 2 is poured to septic tank (illustration omitted)

sludge 1 in a coagulant mixing tank 23, and then solid substances (separated sludge) and part of colloidal, soluble substances 25 are eliminated in a solid-liquid separation tank 24, and the separated liquid is treated by a post-biological treatment (diluted activated sludge method) means. A polymer coagulant is generally used as the coagulant 2, and a gravity separation tank, float separation tank, or mechanical separation tank is used as the solid-liquid separation tank 24. The solid substances 25 eliminated in the solid-liquid separation tank 24 are treated by a sludge treatment process (illustration omitted).

[0004] Incidentally, Fig. 3 shows 26 as diluted water; 27 a dilution adjustment tank; 28 an aeration tank; 29 return sludge; 30 aerated air; 31 a precipitation tank; 32 excess sludge; and 33 treated water.

[0005]

[Problems to be solved by the Invention] The conventional system shown in Fig. 3 has basic problems in a biological treatment facility as the main location.

[0006] (1) Such a facility has only a function to remove organic and solid substances, and thus nitrogen is rarely removed. That is, the facility has a function to remove BOD, part of COD, and SS (suspended substances), but

organic nitrogen and ammonium nitrogen are removed as least as what cleaned bacteria utilize them as the source of nitrogen for their proliferation (around 10 to 15% of poured nitrogen).

[0007] (2) The volume of apparatus is extremely large. That is, the total mean residence time at an undiluted solution flow standard except for the amount of return sludge is three days. To bestow with the nitrogen removal function, this duration must be considered as double or more.

[0008] The present invention has been completed to overcome these basic problems that the conventional system has and to provide a biological treatment method, which has a high rate of nitrogen removal function and a small volume of apparatus.

[0009]

[Means to solve the Problems] The present invention is a method to treat septic tank sludge, comprising: after a coagulant is poured into a liquid in which solid substances of septic tank sludge are separated and removed by a mechanical separation means, the liquid is separated to membrane-permeated water and membrane-thickened fluid by an ultrafiltration membrane separation means; the membrane-thickened water is led to a biological treatment means and

is treated; the membrane-thickened fluid and excess biological sludge caused by the biological treatment means, are circulated by said mechanical separation means and are discharged together as excess sludge to the outside of the system.

[0010] To achieve bestowing with a high rate of nitrogen removal function and reducing the volume of a biological reaction tank simultaneously, both a good scheme for the biological treatment process and reduction in pollutant load (especially nitrogen load) are required, and reinforcement in pre-treatment function and improvement of solid-liquid separation process are needed.

[0011] Therefore, the purposes of the present invention are (1) for not only BOD, COD, and SS but also organic nitrogen to be blocked and thickened in a high rate, applying ultrafiltration membrane, which can remove solid substances and colloids completely, as well as part of soluble substances, as a solid-liquid separation method, (2) pouring a coagulant before the membrane separation and fixating any pollutant ingredients blocked, which simply become thickened substances unless they are fixated, as well as flow out to dehydrated filtrate on the sludge treatment process, and thus they cause a load on the biological treatment after all, (3) introducing both

coagulated sludge caused by the membrane separation and excess biological sludge caused by the biological treatment to the mechanical separation process, taking them out together as excess sludge, and thus unifying the excess sludge generation system.

[0012] That is, characteristics of the present invention are: ① applying the ultrafiltration membrane separation as a pre-treatment of biological treatment in the treatment of septic tank sludge, ② pouring a coagulant before this ultrafiltration membrane separation, and ③ introducing the coagulated sludge caused by the ultrafiltration membrane separation and excess biological sludge caused by the biological treatment to the mechanical separation process before the ultrafiltration membrane separation.

[0013]

[Actions] ① Applying the ultrafiltration membrane separation enables removing BOD, COD, SS, and organic nitrogen, and thus the load applied to the post-biological treatment can be reduced.

[0014] ② Pouring a coagulant enables fixating any pollutant ingredients, such as BOD, COD, and organic

nitrogen, as solid substances, and the membrane permeation flux is increased and stabilized by the aggregation and bulking of minute particles. (The aggregation and bulking of the solid substances and colloids decrease the membrane permeation resistance; maintain a higher permeation flux; and increase the stability of permeation flux.

[0015] ③ Introducing the coagulated sludge and excess biological sludge to the mechanical separation means unifies the excess sludge generation system, and thus the process can be simplified.

[0016]

[Example] One example of the present invention is described below referring to Fig. 1. After the aggregation and bulking of particles were conducted by mixing septic tank sludge 1 and a coagulant 2 in a drug mixing tank 3, the mixture was introduced to a mechanical separation tank 4 and was separated to excess sludge 5 and separated liquid 6. In the mechanical separation tank 4, excess solid substances (SS) were mainly removed, but a few soluble substances were also removed. If any excess solid

/3

substances are removed beforehand, the permeation flux of the post-ultrafiltration membrane can be increased and also

stabilized. This separated liquid 6 and a coagulant 7 were mixed together in a drug mixing tank 8, and aggregation reaction was conducted. Then, the mixture was introduced to an ultrafiltration membrane separation tank 9 to block 100% of SS and most of soluble substances, which were fixated as solid substances by the coagulant and were removed as coagulated sludge 11. This coagulated sludge 11 was circulated forward to the mechanical separation tank 4.

[0017] Membrane permeated water 10 was introduced to a biological treatment process 12, and almost 100% of nitrogen (most of which was ammonium nitrogen) resided a little in the membrane permeated water was removed by the biological digestion nitrogen removal action. Excess biological sludge 13 caused by the biological treatment process 12 was circulated forward to the mechanical separation tank 4 similarly as the coagulated sludge 11. The coagulated sludge 11 and the excess biological sludge 13 were discharged together as the excess sludge 5.

[0018] In here, the fraction molecular weight, module type, and material quality of the ultrafiltration membrane do not matter. As the material quality for the membrane, the ultrafiltration membrane on the market, such as polyacrylnitril and polyolefin, can be simply used. The module can be any of tube type, hollow fiber type, film

type, spiral type, and the like. The excess sludge 5 can be treated in a sludge treatment process (dehydrating, drying, and incinerating, and the like). Examples of the coagulant include aluminum sulfate, ferric chloride, and polymer coagulant.

[0019] To verify effects of the present invention, experiments were conducted by using the experimental equipments as the same as the flow in Fig. 1. Septic tank sludge 1 collected from a raw sewage disposal facility was led to the drug mixing tank 3 to which a prescribed amount of the coagulant 2 was added. The mixture was separated to excess sludge 5 and separated liquid 6 in the mechanical separation tank 4 (in here, centrifugation). This separated liquid 6 was led to the drug mixing tank 8 to which a prescribed amount of the coagulant 7 was added. The mixture was stirred rapidly (the rotation rate of stirring propeller: 120 to 150 r. p. m.) for 120 minutes and slowly (the rotation rate of stirring propeller: 50 r. p. m.) for 30 minutes for the coagulation reaction. Then, the liquid was led to the ultrafiltration membrane separation tank 9, and the membrane separation was conducted in a batchwise manner.

[0020] In here, the basic elements of membrane separation module in the ultrafiltration membrane

separation tank 9 are mentioned below.

① The sort of membrane: material quality - polyacrylnitril (effective area: 0.42 m^2), fraction molecular weight: 100,000.

② Membrane module: tube type

③ Membrane separation conditions: the mean permeation pressure - 1.5 kg/cm^2 G; temperature - 22 to 23 ℃

④ Coagulant: aluminum sulfate, ferric chloride; pouring rate: each 300,500 ppm

[0021] Fig. 2 is a rough drawing of test equipments in the biological treatment process for the membrane permeated water 10 in Fig. 1. The test was conducted separately from the pre-treatment (the process before the ultrafiltration membrane separation tank 9). The test equipments in the biological treatment process in Fig. 2 consisted of an undiluted solution (the membrane permeated water 10) storage tank 15, undiluted solution pump 16, nitrification tank 17, nitrogen removal tank 18, re-aeration tank 19, precipitation tank 20, treated water 21 discharge line, return sludge 22 return line, and excess sludge 13 return line (this excess sludge 13 is returned forward to the mechanical separation tank in Fig. 1).

[0022] The total mean residence time at an undiluted solution (the membrane permeated water 10) flow standard was three days. Nitrification (NH_4, -N oxidization) was conducted for BOD removal in the nitrification tank 17, while oxidized nitrogen produced in the nitrification tank 17 is deoxidized in the nitrogen removal tank 18. Alcohol, if necessary, is poured as the source of carbon. The re-aeration tank 19 is for removing this residual alcohol.

[0023] Table 1 shows the results obtained by the experiment equipments shown in Figs. 1 and 2.

[Table 1]

Unit: ppm (mean values)

	Septic tank sludge mechanical separation liquid	Membrane treatment liquid of mechanical separation liquid	Biologically treated water
BOD	360	65	9
T-N	150	85	18
SS	1,200	0	5

(Note) T-N: the total nitrogen

[0024] T-N in the treated water maintained 20 ppm or less for three days as the total mean residence time for the biological treatment (in the conventional method, 150 to 200 ppm at the exit in the biological treatment process),

and thus it shows that the method of the present invention is bestowed with the higher nitrogen removal function without increasing the volume of biological treatment than the conventional method. The factor is the enhancement in the pre-treatment function by the membrane treatment added.

[0025]

[Effect of the Invention] The present invention enables the high rate of nitrogen removal without increasing the volume of biological treatment equipment.

[Brief Description of the Drawings]

[Fig. 1] A diagram showing one example of the present invention.

[Fig. 2] A diagram showing the biological treatment process in one example of the present invention.

[Fig. 3] A diagram showing one mode of the conventional treatment method for septic tank sludge.

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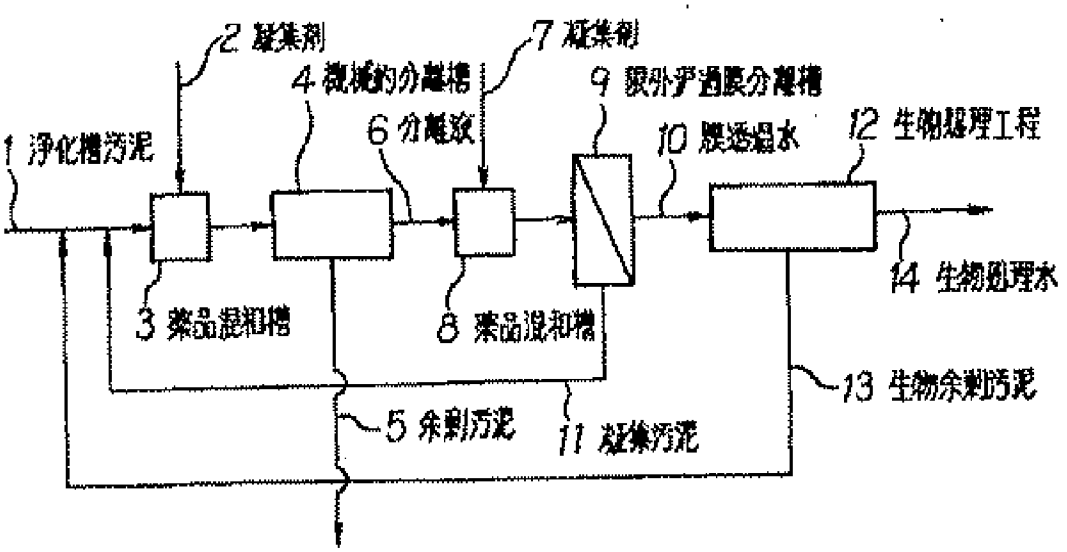
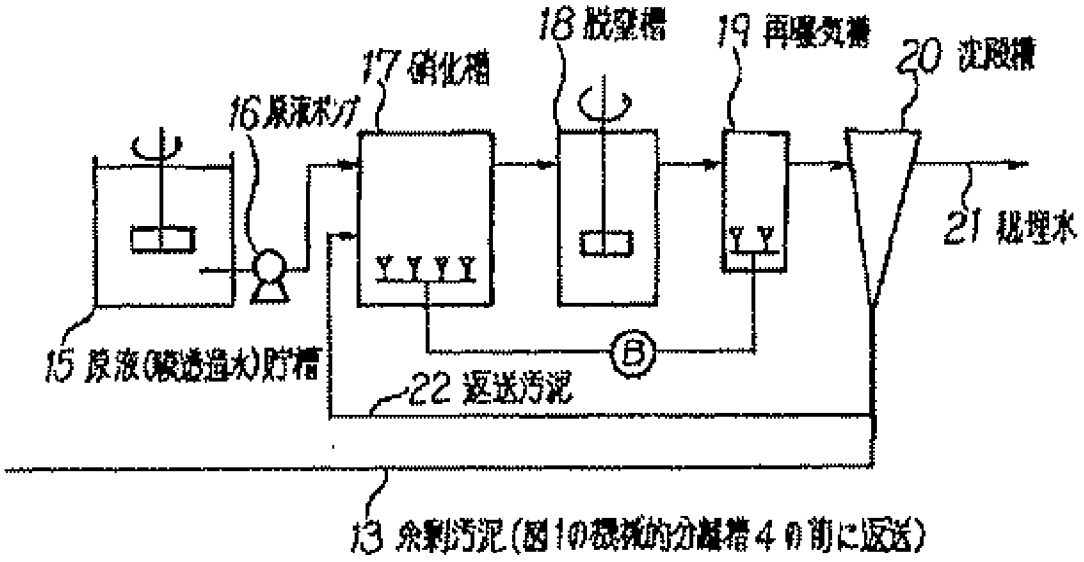
[Fig. 1]



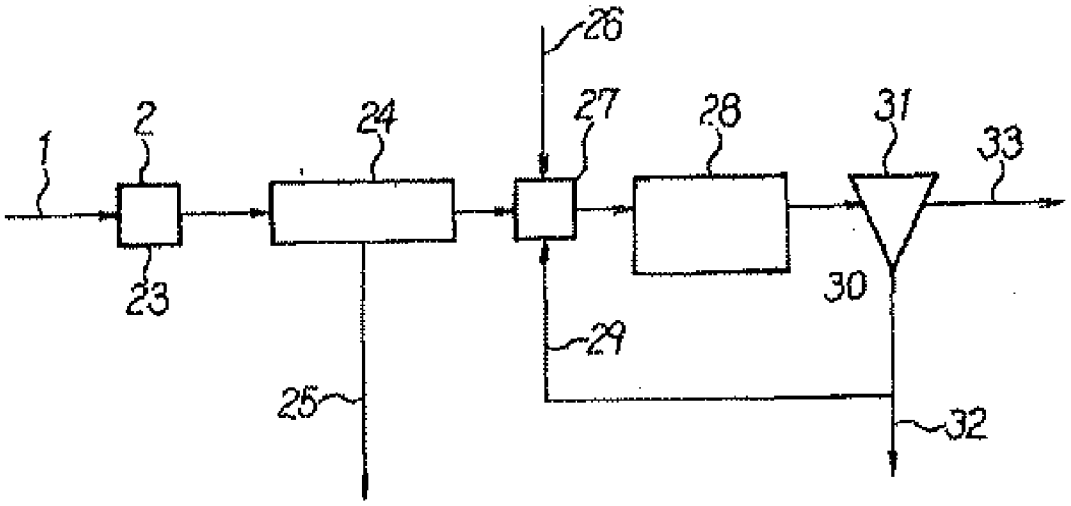
1: septic tank sludge, 2: a coagulant, 3: a drug mixing tank, 4: a mechanical separation tank, 5: excess sludge, 6: separated liquid, 7: a coagulant, 8: a drug mixing tank, 9: an ultrafiltration membrane separation tank, 10: membrane permeated water, 11: coagulated sludge, 12: a biological treatment process, 13: excess biological sludge, 14: biologically treated water

[Fig. 2]



13: excess sludge (to be returned forward to the mechanical separation tank in Fig. 1), 15: an undiluted solution (the membrane permeated water) storage tank, 16: an undiluted solution pump, 17: a nitrification tank, 18: nitrogen removal tank, 19: a re-aeration tank, 20: a precipitation tank, 21: treated water, 22: return sludge

[Fig. 3]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